Informatics Integration in a Medical Residency Program: Early Experiences

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In 1992, Informatics training was integrated into the medical residency program at Norwalk Hospital. The program objective was to familiarize the residents with clinical applications of information technology that could enhance their productivity in clinical practice. In its first year, the curriculum was theory oriented. Evaluation of the program at the end of the first year led to a significant restructuring of the program format and curriculum. The trainees did not find theory to be of immediate clinical value, in the second year the program emphasis was redirected toward the development of practical skills. Next year, in 1993, 'Informatics Clinics' were initiated to develop practical Informatics skills that would be useful in a clinical setting. This approach was more successful but did not offer a complete solution. The degree to which the concepts and methods learned are clinically utilized by residents will depend upon the degree of reinforcement provided in the clinical residency years. In addition, there is a need for the development of assessment standards for the evaluation of Informatics literacy levels. In the absence of assessment standards the level of Informatics literacy in medical graduates remains undetermined Consequently, it is difficult to determine whether the training received has transformed expectations into reality.

INTRODUCTION

An analysis of medical curriculum in 1980, reports that a medical student must assimilate[1]:
- 47,900   facts
- 29,900   concepts

that exist in standard medical text books. At a rate of:
- 24/per hour for first two years, and
- 9/per hour during the clinical phase.

Physicians of the future must develop information management skills to efficiently cope with the information overload. The American Academy of Medical Colleges' "General Professional Education of the Physician" (GPEP) education report was the first to recommend a curriculum shift away from the traditional emphasis on memorization and rote learning toward an emphasis on the ability to access and meaningfully organize information [2]. A medical curriculum should include education about medical data, clinical decision making, information systems, uses of communication networks, and processing knowledge. Training in medical Informatics has been nearly universally recommended in medical education review reports as a necessary tool to support this paradigm shift. Informatics skills are emphasized in reports by the American Medical Association [3], and the Robert Wood Johnson Foundation [4].

These recommendations have resulted in some form of curriculum defined use of computers in 122 medical schools, with 94 of these requiring or specifically offering computer training [3, 5]. Most reports describe Informatics training either in undergraduate medical education [6] or postdoctoral training in programs funded by the National Library of Medicine [7, 8]. Fewer Informatics training courses have been undertaken at the residency level. Hogg has described Informatics training in a Family Medicine residency program that emphasizes computer skills [9]. The latest core curriculum for clinical pathology residency includes Informatics [10]. The residency years offer an excellent opportunity for the acquisition of Informatics skills that would complement the clinical training experience.

In this descriptive paper the early experiences in integration of Informatics into the medical residency training program at Norwalk Hospital are presented. The role of informatics in the residency program is recognized as the objective is to develop life long skills to support "evidence based practice of medicine."

BACKGROUND

Norwalk Hospital is a 350 bed, not-for-profit teaching facility that serves an area population of 250,000. It draws patients for special services from

the entire New England region. For example, since 1970, it has had the only hospital-based hyperbaric service in New England. It's Internal Medicine residency program is affiliated with the Yale University School of Medicine. The hospital also has academic ties with the Finch University of Health Sciences/Chicago Medical School (FUHS/CMS), for clinical and medical Informatics training for 3rd and 4th year medical students. In addition, medical students from other medical schools perform clinical clerkships in Internal Medicine and subspecialties.

There are 36 medical residents, of which 18 are Post-graduate Year (PGY)--1's along with 9 each as PGY-2's, and PGY-3's. There is a radiology residency program, with fellowships available in gastroenterology, cardiology and pulmonary/critical care.

MEDICAL INFORMATICS PROGRAM

In 1992, the Center for Medical Informatics was established within the Beulah Hinds Center, part of the Section of Pulmonary/Critical Care at our hospital. The Beulah Hinds Center, founded in 1972, has provided leadership and pioneering initiatives in the clinical implementation of computers within the hospital. A Section for Medical Informatics in the Department of Medicine was established in 1995.

Medical Informatics training was integrated into the Internal Medicine residency curriculum in 1992. A residency training program must include information management skills to enable the trainee to remain competitive in the decades of practice ahead. Medical Informatics is an emerging scientific area that is interdisciplinary in nature, overlapping with the fields of electronic engineering, the social science of organizational dynamics and the study of human behavior. There is no explicit agreement on the skill standards or methods to evaluate computer literacy in medical or allied health students.

The decision to initiate the Medical Informatics Training Program (MITP) for residents posed a challenge as there were few prior models on which to draw. Developing a curriculum for Informatics is challenging, as described by Davidoff [11], "most difficult is the problem of trying to absorb the arcane and alien mysteries of the instrument--the hardware and software--at the same time you are trying to understand the deeper problems of medical information management." In 1992, reports described curriculums for education in Informatics in undergraduate health education curriculums [12, 13, 14]. These programs often placed emphasis on the

areas in which the program directors had a research interest [15].

The objectives and framework of the MITP were agreed upon after a series of meetings by the authors (KM, SN) with the residency program director (JC), the chief medical resident and the chairperson of the Department of Medicine. The program objectives were defined as follows:

- provide theoretical and hands-on Informatics training to the residents
- develop familiarity and experience with some clinical decision support applications
- develop the ability to access and retrieve information from literal databases

The goal was to develop Informatics skills to enhance performance in clinical practice. There was time allocated, and official sponsorship accorded to the program. It was also agreed that the program would not intrude on clinical training; the primary objective of a residency program. The program experienced two distinct periods over the two years that is presented in this paper.

FIRST YEAR EXPERIENCES

A program of lecture sessions was constructed to provide a theoretical understanding required for functional skills. A residents workstation was developed with clinical decision support applications and installed in the resident work areas for practical experience. The first year was dominated by a lecture series, and the curriculum was covered in approximately 14 seminars composed of the following topics:

- Clinical Informatics Introduction
- Introduction Computer Hardware & Software
- Medical Data
- Medical Data: The Vocabulary and Semantics
- Medical Decision Making
- Knowledge Based Systems
- Database Management Systems
- Clinical Information Systems
- Ambulatory Information Systems
- Medical Literature Databases
- Laboratory Support Systems
- Computer Assistance in Medical Education

The lectures took place as part of the residents' regular afternoon lecture series. As part of each lecture, clinical application of the theory presented was demonstrated with an application on the workstation.

The Residents Work Station was developed in 1992 on a 386 DELL computer with 8 Mbytes of RAM,

included a CD-ROM and was linked to a printer. A set of commercially available clinical decision support software was integrated under a Windows® operating system. The window's environment was considered easiest to use.as it permitted an icon based graphic interface. A small routine in the batch files, which was initiated by clicking on the icons, was used to log all instances of program use.

The computer workstations were placed in the residents' work-rooms on the two teaching floors and in the primary care residents work area. Programs installed included several CD-ROM disks based programs. Each workstation had:

- Grateful Med--to search on MEDLINE the host on the National Library of Medicine.

- QMR (Quick Medical Reference)-- a knowledge based program for diagnostic work-up from the input of complaints; symptoms, signs and lab findings.

- AskRx-- a drug information program providing information on drug-drug interactions, side effects, diseases caused by certain drugs and drug to avoid in certain diseases.

- Scientific American -- a clinical text book reference, that includes pictures, graphs, and tables on a CD-ROM.

- PDR (Physicians Desk)-- a CD-ROM version of the pharmaceutical data reference

- MAXX-- a CD-ROM based text book reference program with protocols for medical care.
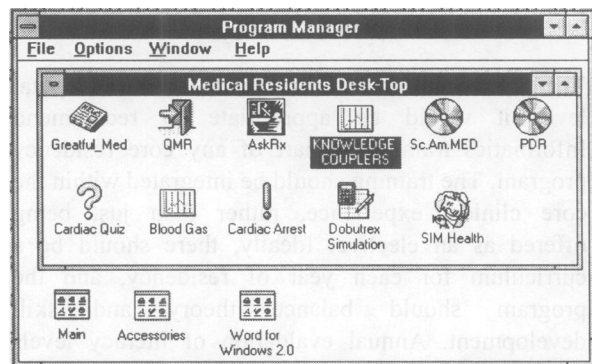

Figure 1 Medical Resident Work Station screen showing decision support tools

Several simulation packages were also available, such as an arterial blood gas tutor, Cardioquiz, SimHealth, Dobutrex simulator and a myocardial infarction simulator. A word processor was also included on all stations. These software programs assisted the residents' education program in clinical decision making (See Figure 1).

SECOND YEAR CORRECTIONS

After reviewing the first year program it was evident that the program needed a shift in emphasis, away from theoretical knowledge towards practical skill development in a clinical setting.

An application for data collection was introduced as the program shifted its emphasis. A computer-based patient record system, then in development, from The Finch Univ. of Health Sciences / Chicago Medical School, known as Intelligent Medical Record Entry (IMRE) was used. The systems design foundation is a data set defined and implemented in a graphical application to enter data. The system automatically formatted the history and physical entered into written text that could then be printed out or stored for future reference [16]. (Figure 2)
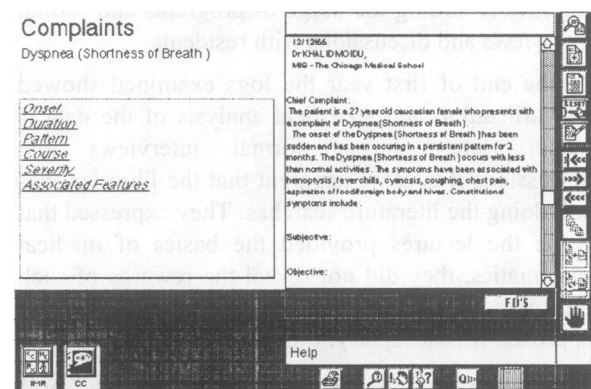

Figure 2 Text generated by IMRE as clinical information was selected from data templates

The next year a series of *Informatics Clinics* was conducted on the patient care floors. The class consisted of smaller (6-8 person) groups of residents together with a tutor and were held in the resident workrooms on the floors. A clinical case scenario was used to demonstrate the assistance Informatics tools provided. Data was collected using IMRE and the printout was the case presentation. This was followed by application of clinical informatics applications to do a work-up of the diagnosis, assess the therapeutic plan or gather evidence to support the management of the case at hand. The differential diagnoses lists compiled by residents would be compared to a list generated by QMR or the drug interactions list reviewed using Ask Rx. In difficult cases the management options researched by access to literal knowledge resources, such as MEDLINE or Scientific American Textbook of Medicine.

DISCUSSION

The goal of the Medical Informatics Training Program was to create an awareness of clinical

application programs and develop skills for information management. The varying levels of computer literacy among the residents of computer literacy provided a hurdle in designing the curriculum. A combination of a core curriculum in medical Informatics and hands-on experience was considered adequate to insure development of Informatics skills and enhance the clinical use of such a system [17, 18]. The theory was delivered in lectures that were attended by residents as and when they were able to attend. The *Informatics clinics* were always held on a patient floor and residents during that rotation devoted some time for Informatics. Clinical software applications included in the design of the workstations were selected to provide decision support. The evaluation of the program was based on examination of the computer log files recording the usage of programs and formal interviews and discussions with residents.

At the end of first year the logs examined showed low utilization and statistical analysis of the data is inappropriate. During formal interviews and discussions it became apparent that the librarian was still doing the literature searches. They expressed that while the lectures provided the basics of medical Informatics, they did not reveal the rewards of such information quickly enough. Indeed, a second approach was necessary.

The next year a series of *Informatics Clinics* was conducted on the patient care floors. The class consisted of smaller (6-8 person) groups of residents together with a tutor. These smaller, interactive sessions were much more successful in the meaningful incorporating computers as a clinical tool for the residents. Examination of the logs at the end of the second year showed programs had been used at least once each day. The relative frequency of use of different programs provided an insight into the support the residents sought. The most frequently used programs were the Scientific American Textbook of Medicine, Grateful Med, Ask Rx, PDR on CD-ROM. The program QMR was less frequently used, among the games SimHealth was used in 1993 as the health policy dominated the media. The residents were now conducting their MEDLINE searches in the library. The residents described their experiences with the medical desktop workstations as useful.

The senior residents (those in their second and third years of training) having had the theoretical foundation from the first year found the clinic approach most meaningful. Residents who entered the second year of the program were less comfortable. A significant number expressed concerns about the difficulty of using various programs. Specifically, the problem of finding the appropriate combination of words or phrases for a MEDLINE search.

There is an expectation that the "Nintendo generation" will be more computer literate which will facilitate the introduction of computer into the clinical environment. A recent study reported that the attitudes toward computer-aided learning were related to computing confidence. The study reports that medical students who have not acquired basic computer and information technology skills in the first two years of undergraduate training are unlikely to do so in the final, hospital-based years. They strongly recommend that undergraduate curriculums for medical students incorporate specific computer training [19].

The issue to Address as investments are made in information technology that adequate emphasis be placed on training. Residents familiar with Informatics could work as agents of change. The workstation approach limits the data capture and to increase the clinical productivity of information systems the solution exists in using machines that are smaller and faster. Personal Digital Assists (PDA's) are beginning to help solve this dilemma. At Norwalk we are in the process of adopting Newton 130 PDAs for data collection at the point of care along with a software application for data capture - Pocket DOC.

CONCLUSION

The experience for the faculty is that at a conceptual level it would be appropriate to recommend Informatics training as part of any core residency program. The training should be integrated within the core clinical experience, rather than just being offered as an elective. Ideally, there should be a curriculum for each year of residency, and the program should balance theory and skill development. Annual evaluation of literacy levels needs to be done and a required level of competence must be achieved before awarding a resident with certification of program completion.

The degree to which these concepts and methods are actually utilized by students will depend upon how well they are reinforced in the clinical residency years. Success will also depend on faculty members acting as role models, not only by acknowledging the

importance of mastering the use of computers in medicine, but also by manifesting those skills.

Acknowledgments

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